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MEMORANDUM

TO: Mr. Corey York, PLS, Town Engineer/Director of Public Works

FROM: John Michalak, PE, ENV SP
Adina Alpert, PE, PTOE

DATE: December 18, 2019

RE: Preferred Design Concept for Main Street (Route 27) at Prospect Street

BACKGROUND AND PURPOSE

The Town of Acton retained Nitsch Engineering (Nitsch) to develop conceptual level plans associated with the Public Infrastructure Improvement Plan for the intersection of Main Street (Route 27) at Prospect Street. Nitsch prepared and submitted to the Town an Existing Conditions Memorandum, dated June 21, 2018 and a Conceptual Design Options Memorandum, dated September 5, 2018. We facilitated Public Outreach Meetings on June 27, 2018 and December 6, 2018. At these meetings we solicited comments from attendees and presented conceptual design plans for discussion and feedback.

CONCEPT PLANS

As a result of our traffic analysis and the comments provided by the public and Town officials, we evaluated four conceptual design options: two unsignalized concepts, one signalized concept, and one roundabout concept. The concepts are summarized below and included as an attachment to this memorandum.

Unsignalized Concept 1

In this concept, raised islands direct traffic to and from Prospect Street, limiting some turning movements and eliminating some of the existing conflict points. Turning movements that are permitted are accommodated at two nodes, similar to existing, one on the north end of the intersection and one on the south end.

The Prospect Street northeast-bound approach curves to meet Main Street at a right angle at the south node. The approach is STOP-controlled, and all traffic in this lane must turn right or left onto Main Street. To continue to the northwest-bound Prospect Street departure, vehicles on that approach must first turn left onto Main Street, then make a soft-left turn onto Prospect Street at the north node.

The Prospect Street southeast-bound approach does not meet Main Street, instead curving to the right to continue to the Prospect Street southwest-bound departure. Accordingly, turning movements from southeast-bound Prospect Street onto Main Street are not accommodated. This approach is a free movement, stopping only for pedestrians crossing at the south node.

The northbound and southbound Main Street approaches are free movements, stopping only for pedestrians crossing at the crosswalks. The soft-right turn movement from southbound Main Street to southwest-bound Prospect Street has an auxiliary lane to separate it from through-moving southbound traffic, and it enters Prospect Street at the south node, merging with traffic coming from southeast-bound Prospect Street. The northbound Main Street sharp-left turn onto southwest-bound Prospect Street is not accommodated. The Main Street northbound soft-left and southbound hard-right turns onto northwest-bound Prospect Street are accommodated at the north node.

All approaches and departures are single lanes, except there is the auxiliary lane between intersection nodes for the Main Street southbound soft-right turn.

Bicycle lanes are provided on both sides of Main Street and are continuous through the intersection. Crosswalks are present across Main Street at both ends of the intersection, as well as across all three lanes at the south node and across the northwest-bound departure lane at the north node. Sidewalks line both sides of all roadways, and sidewalks are present across the islands.

Unsignalized Concept 2

This concept is similar to Unsignalized Concept 1 for the Prospect Street northeast-bound approach lane at the south node and the northwest-bound departure lane at the north node. However, instead of islands, a large bump-out is present along the west edge of the intersection, disconnecting any direct movements between the two legs of Prospect Street.

The Prospect Street southeast-bound approach curves to meet Main Street at a right angle. The approach is STOP-controlled, and all traffic in this lane must turn right or left onto Main Street. To continue to the southwest-bound Prospect Street departure, vehicles on that approach must first turn right onto Main Street, then make a soft-right turn onto Prospect Street at the south node.

At the south node, northbound Main Street traffic can turn left, and southbound Main Street traffic can turn right onto southwest-bound Prospect Street.

All approaches and departures are single lanes.

Bicycle lanes are provided on both sides of Main Street and are continuous through the intersection. Crosswalks are present across Main Street at both ends of the intersection, as well as across each pair of approach-departure lanes at the south and north nodes of the intersection. Sidewalks line both sides of all roadways, and sidewalk is also present on the back side of the bump-out.

Signalized Concept

In this concept, a large island is present to separate the two Prospect Street approaches, with a slip-lane for the southeast-bound soft-right turn movement to the southwest-bound departure. For all other turning movements from the Prospect Street approaches, the approaches curve to meet Main Street at a right angle, as in Unsignalized Concept 2. For traffic on the northeast-bound approach to continue to the northwest-bound departure, vehicles on that approach must first turn left onto Main Street, then make a soft-left turn onto Prospect Street at the north node, same as in the two unsignalized concepts. Stop bars are present on both approaches to Main Street as well as across the slip-lane at the south node.

Turns from northbound and southbound Main Street to southwest-bound Prospect Street are made at the south node, and turns from northbound and southbound Main Street to northwest-bound Prospect Street are made at the north node, same as in Unsignalized Concept 2. An exclusive left-turn lane is provided for Main Street northbound for the approaches at both nodes. Two stop bars are present for the northbound approach, one at each node. The southbound approach has a stop bar at the north node.

Bicycle lanes are provided on both sides of Main Street. The southbound bicycle lane is continuous through the intersection, but the northbound bicycle lane is present only to the north of the intersection, with the through travel lane marked as a shared lane (with “SHARROW” pavement markings) on the approach and through the intersection. Crosswalks are present across Main Street at both ends of the intersection, as well as across

each pair of approach-departure lanes at the south and north nodes of the intersection and across the slip-lane at the south node.

All movements are signalized, and the traffic signal operates in five phases. In the first phase, northbound Main Street proceeds with protected left turns at both nodes. In the second phase, northbound Main Street continues with left-turns now permitted instead of protected, and southbound Main Street proceeds. In phase three, the northeast-bound Prospect Street approach proceeds with all movements protected, including the two-stage turn onto northwest-bound Prospect Street. The southeast-bound to southwest-bound Prospect Street slip-lane also proceeds in this phase. In phase four, the southeast-bound Prospect Street approach proceeds, with all movements protected, including the slip-lane. The fifth phase is an exclusive pedestrian phase for all the crossings at the intersection. Sidewalks line both sides of all roadways, and sidewalk is present across the island.

Roundabout Concept

This concept converts the intersection into a modified single-lane roundabout configuration, often referred to as a “peanut.” This type of roundabout is created by placing two roundabouts at close proximity to each other such that they blend together with one center island and a single path of traffic circulation around the exterior. The resulting shape resembles a peanut, with round lobes on the two ends and a narrower strip connecting them. The narrow portion in the middle allows for continuous deflection of the circulating lanes, maintaining the speed control of the roundabout. It also results in a smaller footprint than an oval shape would have, which generally has less of an impact on the right-of-way.

At this intersection, the roundabout’s inscribed circle diameter is slightly larger at the south node than at the north node, making for an asymmetrical peanut shape. The central island would be a mountable truck apron, with non-mountable portions in the center of the south node’s circle and through the narrow strip between nodes, but not in the center of the north node’s circle.

All four legs of the roundabout have a splitter island, a single approach lane, and a single departure lane. Crosswalks are present across all legs with pedestrian refuge in the splitter islands. Sidewalks line both sides of all roadways (but not the center island).

Bicycle lanes are provided on both sides of Main Street on the approaches and departures, with the lane designated a shared lane (with “SHARROW” pavement markings) nearest the roundabout on the northbound and southbound approaches and the northbound departure.

SUMMARY OF OPERATIONAL ANALYSIS

Our traffic models indicate that the Roundabout Concept would provide the best traffic operations in the design year 2028 out of all four concepts presented, with the intersection operating at an overall Level of Service (LOS) B and all movements operating at LOS C or better. The Signalized Concept would provide the next best traffic operations, with the intersection operating at an overall LOS C and all movements operating at LOS D or better, except the left-turn movement from southeast-bound Prospect Street to Main Street, which is expected to operate at LOS E. The Signalized Concept provides further operational benefits over the Roundabout Concept, including emergency vehicle considerations, as described in the Design Concept Selection section below, and additional protection for pedestrians with an exclusive pedestrian phase in the signal cycle.

COMPARISON OF CONCEPTS

The benefits of Unsignalized Concept 1 include:

- Fewer conflict points than existing and Unsignalized Concept 2 (all turning movements from Prospect Street to Main Street are condensed to the south node), and
- Relatively low cost and maintenance

The disadvantages of Unsignalized Concept 1 include:

- Continued delay for Prospect Street left turns

The benefits of Unsignalized Concept 2 include:

- Fewer conflict points than existing, and
- Relatively low cost and maintenance

The disadvantages of Unsignalized Concept 2 include:

- More conflict points than Unsignalized concept 1, and
- Continued delay for Prospect Street left turns

The benefits of the Signalized Concept include:

- Exclusive pedestrian phase, and
- Less delay for Prospect Street compared to unsignalized concepts

The disadvantages of The Signalized Concept include:

- Longer vehicle queues along Main Street compared to unsignalized and roundabout concepts, and
- Relatively high cost and maintenance of signal equipment

The benefits of the Roundabout Concept include:

- Significantly fewer conflict points than unsignalized and signalized concepts,
- Least amount of overall delay of all the concepts, and
- Relatively low maintenance

The disadvantages of the Roundabout Concept include:

- Relatively high cost
- Potential ROW impacts – Permanent and Temporary Easements

CONCLUSION AND RECOMMENDATION

Comments received at the public meeting held on December 6, 2018 were generally in favor of implementing some form of intersection modifications to improve traffic and pedestrian safety. The attendees acknowledged that the unsignalized concepts would provide some improvement to vehicular safety but would not improve traffic flow or the ability for vehicles to turn onto Main Street. The roundabout option was unacceptable to one of the direct abutters to the project, even though a roundabout would provide the greatest improvement to traffic flow, while reducing vehicle speeds and improving vehicular and pedestrian safety. The signalized intersection provides a traffic circulation and safety advantage in that it will allow better access to Main Street from Prospect Street and provides improvements to pedestrian safety by implementing an exclusive pedestrian crossing phase at the intersection, however, Main Street will experience traffic queues on the approaches to the signalized intersection.

We received additional comments from the Town in May 2019 provided by Town Public Safety officials recommending the Signalized Concept for the intersection. The primary reason for their recommendation is

that emergency vehicle preemption can be implemented with a traffic signal. An emergency vehicle preemption system detects approaching emergency vehicles and preempts normal signal operation, halting conflicting traffic while allowing emergency vehicles the right of way, to help reduce response times and enhance traffic safety. Furthermore, the other three concepts under consideration, the two unsignalized and the roundabout concept, involve geometric changes to help reduce traffic speeds and restrict certain turning movements, particularly those involving Prospect Street. Public Safety is concerned about such traffic-calming measures reducing response times for emergency vehicles.

Although there seemed to be a general acceptance by the attendees at the Public Outreach Meeting that the roundabout option would provide the best improvements to traffic flow at the intersection, it was evident that the installation of a traffic signal is more familiar and therefore would likely be more acceptable to the public. Based on the comments received at the Public Outreach Meetings as well as the comments and recommendation from Public Safety, the acceptable level of traffic operations in the design year, and other benefits, we recommend the Signalized Concept to be advanced to the design stage.

LEGEND

- Grass
- Roadway
- Sidewalk
- Detectable Warning Panel
- Solid White Line
- Solid Yellow Line
- Property Line

0 30 60 100

SCALE: 1" = 30'

MAIN STREET AND PROSPECT STREET
UNSIGNALIZED CONCEPT 1

ACTON, MASSACHUSETTS

PREPARED FOR:
TOWN OF ACTON

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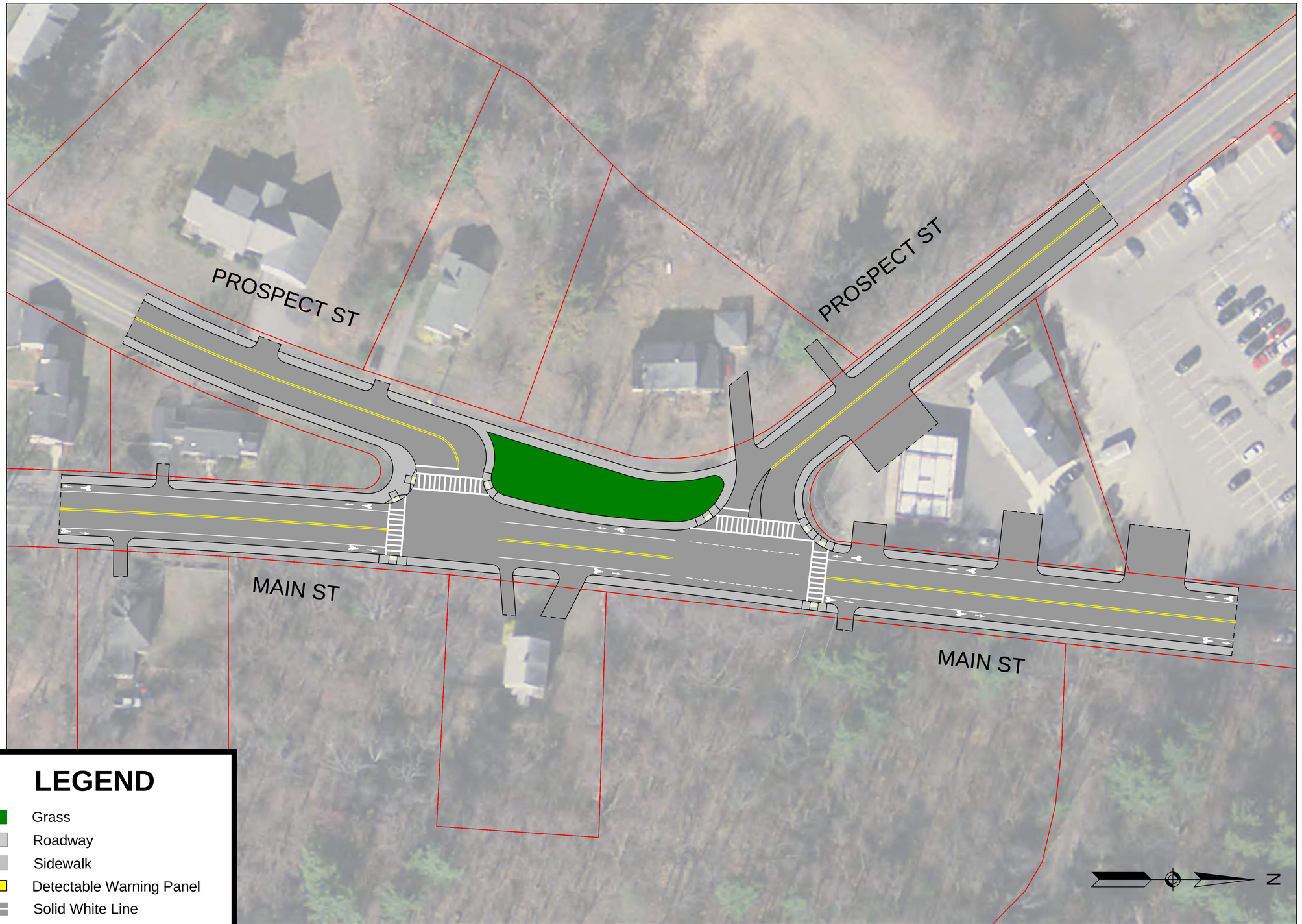
- Civil Engineering
- Land Surveying
- Transportation Engineering
- Structural Engineering
- Green Infrastructure
- Planning
- GIS

REV.	COMMENTS	DATE
	REVISIONS	

NITSCH PROJECT #	
FILE:	
SCALE:	AS NOTED
DATE:	8/24/2018
PROJECT MANAGER:	J.MICHALAK
SURVEYOR:	
DRAFTED BY:	T. PRESUME
CHECKED BY:	J.MICHALAK



LEGEND

- Grass
- Roadway
- Sidewalk
- Detectable Warning Panel
- Solid White Line
- Solid Yellow Line
- Property Line

0 30 60 100

SCALE: 1" = 30'

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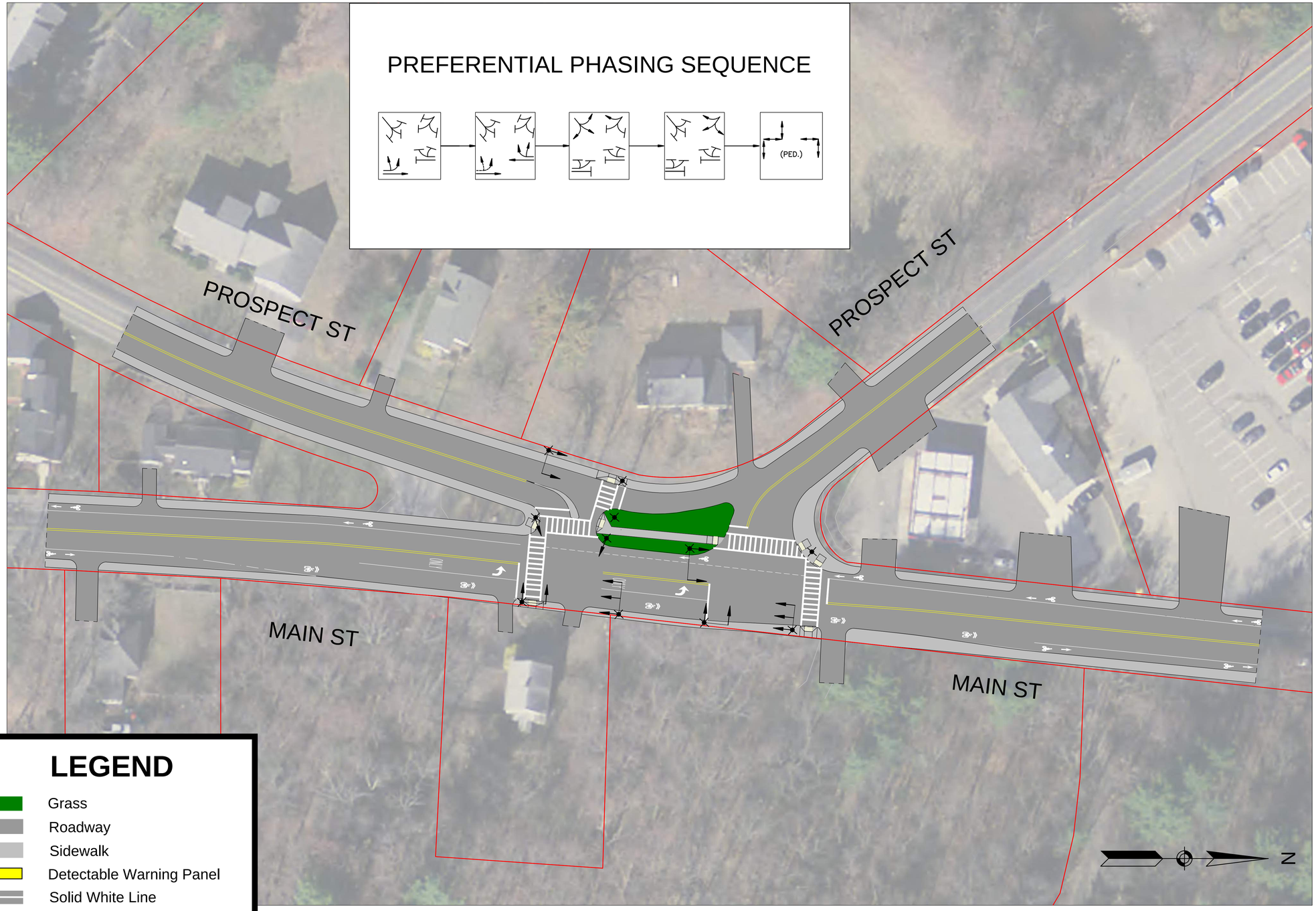
MAIN STREET AND PROSPECT STREET UNSIGNALIZED CONCEPT 2

ACTON, MASSACHUSETTS

PREPARED FOR:
TOWN OF ACTON

REV.	COMMENTS	DATE
	REVISIONS	

NITSCH PROJECT #	
FILE:	
SCALE:	AS NOTED
DATE:	8/22/2018
PROJECT MANAGER:	J.MICHALAK
SURVEYOR:	
DRAFTED BY:	T.PRESUME
CHECKED BY:	J.MICHALAK



LEGEND

- Grass
- Roadway
- Sidewalk
- Detectable Warning Panel
- Solid White Line
- Solid Yellow Line
- Property Line

0 30 60 100

SCALE: 1" = 30'

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MAIN STREET AND PROSPECT STREET SIGNALIZED CONCEPT

ACTON, MASSACHUSETTS

PREPARED FOR:
TOWN OF ACTON

REV.	COMMENTS	DATE
	REVISIONS	

NITSCH PROJECT #	
FILE:	
SCALE:	AS NOTED
DATE:	8/22/2018
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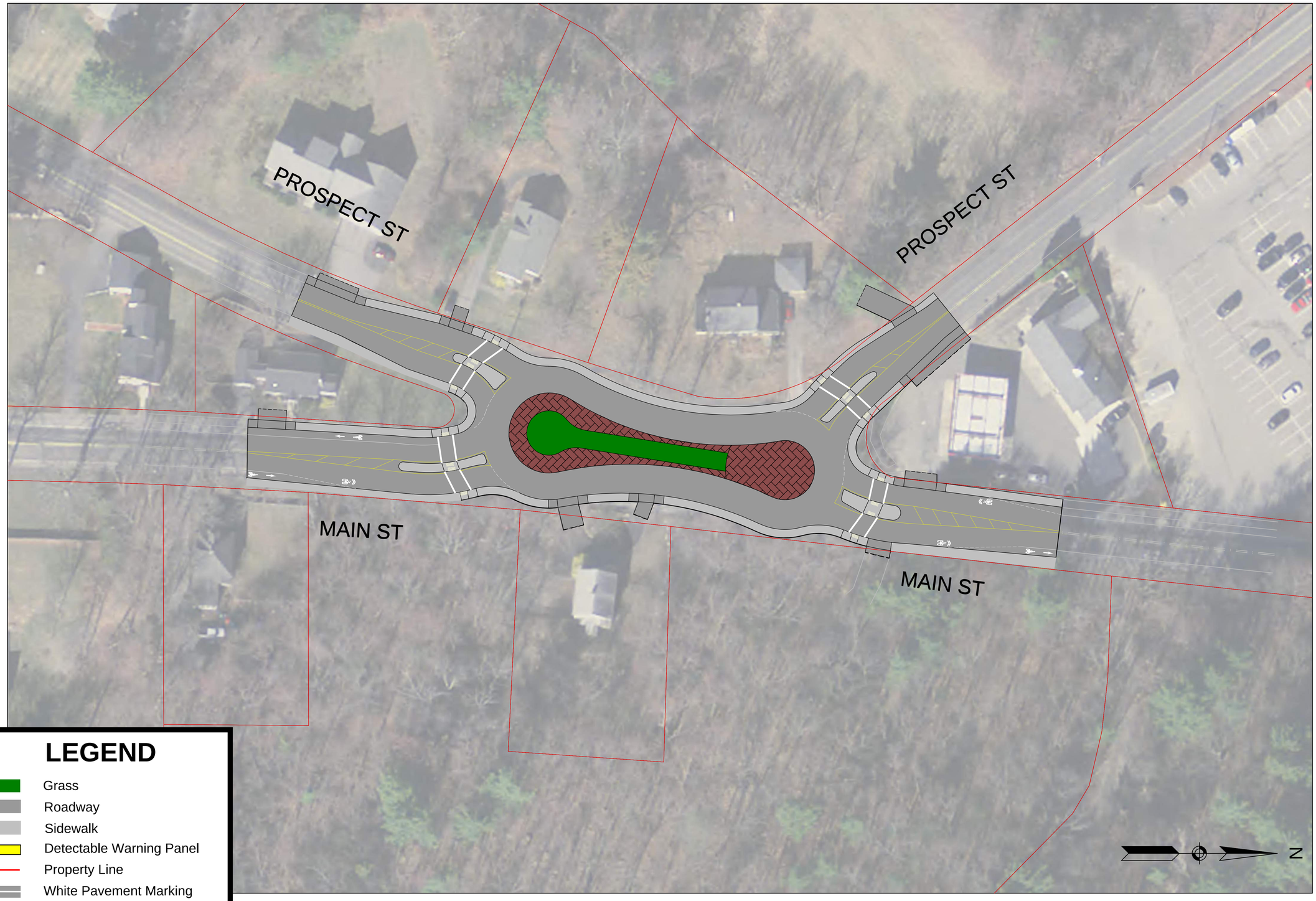

LEGEND

- Grass
- Roadway
- Sidewalk
- Detectable Warning Panel
- Property Line
- White Pavement Marking
- Yellow Pavement Marking
- HMA Truck Apron

0 30 60 100

SCALE: 1" = 30'

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ROUNDABOUT CONCEPT

ACTON, MASSACHUSETTS

PREPARED FOR:
TOWN OF ACTON

REV.	COMMENTS	DATE
	REVISIONS	

NITSCH PROJECT #	
FILE:	
SCALE:	AS NOTED
DATE:	8/24/2018
PROJECT MANAGER:	J.MICHALAK
SURVEYOR:	
DRAFTED BY:	J. PERKINS
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